

## PCT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
 US Department of Commerce  
 United States Patent and Trademark  
 Office, PCT  
 2011 South Clark Place Room  
 CP2/5C24  
 Arlington, VA 22202  
 ETATS-UNIS D'AMERIQUE  
 in its capacity as elected Office

Date of mailing (day/month/year) 04 July 2001 (04.07.01)	
International application No. PCT/US00/26462	Applicant's or agent's file reference 22402-PCT
International filing date (day/month/year) 27 September 2000 (27.09.00)	Priority date (day/month/year) 27 September 1999 (27.09.99)
Applicant KIM, Myung, K.	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
 25 April 2001 (25.04.01)

☐ in a notice effecting later election filed with the International Bureau on:  
 \_\_\_\_\_

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Juan Cruz Telephone No.: (41-22) 338.83.38
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# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>22402-PCT</b>	<b>FOR FURTHER ACTION</b>		see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. <b>PCT/US 00/26462</b>	International filing date (day/month/year) <b>27/09/2000</b>	(Earliest) Priority Date (day/month/year) <b>27/09/1999</b>	
Applicant <b>UNIVERSITY OF SOUTH FLORIDA DIVISION OF PATENTS...</b>			

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

**6** \_\_\_\_\_  
☐ None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/26462

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 G03H1/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G03H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>DATABASE WPI Section EI, Week 199820 Derwent Publications Ltd., London, GB; Class S02, AN 1998-229107 XP002156897 &amp; RU 2 090 838 C (ALEKSANDROV S A), 20 September 1997 (1997-09-20) abstract</p> <p style="text-align: center;">--- -/--</p>	1, 11



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*G\* document member of the same patent family

Date of the actual completion of the international search

10 January 2001

Date of mailing of the international search report

19/01/2001

Name and mailing address of the ISA

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Krametz, E

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/26462

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	<p>KIM M K: "WAVELENGTH-SCANNING DIGITAL INTERFERENCE HOLOGRAPHY FOR OPTICAL SECTION IMAGING" OPTICS LETTERS, OPTICAL SOCIETY OF AMERICA, WASHINGTON, US, vol. 24, no. 23, 1 December 1999 (1999-12-01), pages 1693-1695, XP000955284 ISSN: 0146-9592 cited in the application page 1693, left-hand column, paragraph 2 -page 1695, right-hand column, paragraph 1 figures</p> <p>-----</p>	<p>1, 3, 4, 6-14, 17, 18, 20</p>

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/26462

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
RU 2090838 C	20-09-1997	NONE	

## PATENT COOPERATION TREATY

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REC'D 04 JAN 2002

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 22402-PCT	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/26462	International filing date (day/month/year) 27/09/2000	Priority date (day/month/year) 27/09/1999
International Patent Classification (IPC) or national classification and IPC G03H1/08		
Applicant UNIV. OF SOUTH FLORIDA DIV. OF PATENTS..... et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 9 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  25/04/2001	Date of completion of this report  28.12.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Noirard, P  Telephone No. +49 89 2399 2420  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US00/26462

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):  
**Description, pages:**

1-24 as originally filed

**Claims, No.:**

1-20 as originally filed

**Drawings, sheets:**

1/9-9/9 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US00/26462

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-10,13,15,16,19
	No:	Claims	11,12,14,17,18,20
Inventive step (IS)	Yes:	Claims	1-10
	No:	Claims	13,15,16,19
Industrial applicability (IA)	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations  
**see separate sheet**

**VI. Certain documents cited**

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US00/26462

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**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1.1 Reference is made to the following documents :

**D1:** CUCHE E; POSCIO P; DEPEURSINGE C, "OPTICAL TOMOGRAPHY AT THE MICROSCOPIC SCALE BY MEANS OF A NUMERICAL LOW COHERENCE HOLOGRAPHIC TECHNIQUE" - Conference Proceedings Article - PG - 61-66 - PROCEEDINGS OF THE SPIE, SPIE, BELLINGHAM, VA, US - 1996

**D2:** CUCHE E; BEVILACQUA F; DEPEURSINGE C : 'DIGITAL HOLOGRAPHY FOR QUANTITATIVE PHASE-CONTRAST IMAGING', OPTICS LETTERS, OPTICAL SOCIETY OF AMERICA, WASHINGTON, US , 01. March 1999, vol. 24, no. 5, pages 291 to 293

**D3:** WO 00/20929 A

Note: The references in brackets {...} relate to passages in the present application.

1.2 Although not cited in the search report, the documents **D1-D3** are considered relevant and are therefore introduced by the examiner.

1.3 Negative statements : claims 11, 12, 14, 17, 18, 20 lack novelty (Article 33(2) PCT), and claims 13, 15, 16, 19 do not involve an inventive step (Article 33(3) PCT).

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2. As far as the independent claim 11 and dependent claims 12,14,17,18,20 can be understood (see item VIII, below), their subject matter lacks novelty (Article 33(2) PCT) having regard to the teaching of document **D1** for the following reasons :-

2.1 Document **D1** discloses (see Fig. 1 and §3) a system suitable for imaging 3D objects comprising :-

- \* illumination means tunable between two wavelengths (cf. the He-Ne and Ti:sapphire lasers);

- \* means for splitting radiation into object and reference beams (see the beam splitter "PBS");

- \* means for directing the object beam to illuminate the object (cf. the same beam splitter "PBS");

- \* means for digitally recording the interference pattern (see the "CCD");

\* a means (cf. the computer, Fig. 1) suitable for computing and adding the reconstructed holographic images.

Therefore, the system disclosed in **D1** anticipates **claim 11**.

Remark : **D1**'s system can be used to perform all the steps of the method stated in present claim 1.

2.2 In addition, **D1** shows in §3 and in Fig. 1 :

\* that the illumination means comprises a source of coherent radiation (e.g. the He-Ne laser){**claim 12**};

\* a means for magnifying radiation (cf. the Beam Expander "BE") {**claim 14**};

\* that the recording means comprises a CCD array (see Fig. 1) {**claim 17**};

\* a means for magnifying the interference pattern (cf. the "magnification optics" in Fig. 1) {**claim 18**} (see also item VIII, §7.7);

\* a means for combining the reference and image beams (see the beam splitter "PBS") {**claim 20**}.

Hence, the subject matter of claims 12,14,17,18,20 is not new.

3. As far as they are understood (see section VIII below), the dependent claims 13,15,16,19 cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons :-

Hereafter, document **D1** will be considered as closest prior art, which features in common with the claims have already been listed in §2., above.

3.1 Adding to the system a neutral density filter is considered to be common in the art and can be hinted at from document **D2** (see in Fig. 1 the two neutral density filters "NF") {**claim 19**}, which document **D2** teaches a system also performing 3D imaging using holographic numerical reconstruction.

3.2 Furthermore, the addition of aperturing means {**claims 15, 16**} and the choice of a specific laser source {i.e. the "ring dye laser", **claim 13**} to the known system of claim 11 comes within the customary practice followed by skilled persons. Consequently, the subject matter of claims 13, 15, and 16 lacks an inventive step.

4.1 As far as it can be understood (see item VIII, below), the method recited in claim 1 of the present application differs from the available prior art in that none of the prior art documents discloses the steps of

- \* recording interference patterns at a succession of different wavelengths, and then
- \* adding each reconstructed holographic images.

Moreover, the addition of these steps cannot be hinted at from the prior art.

The known method of contour interferometry (quoted in the present description page 7, last paragraph) involves the interference of holograms recorded at two different wavelengths but requires a telecentric viewing system between the object and the recording plate and produces a contour map of the object, not a 3D image of it.

Therefore, **claim 1** fulfils the requirements of novelty and inventive step (Article 33(2) and 33(3), PCT).

4.2 Dependent **claims 2 to 10** relate to preferred embodiments of the method of claim 1. These claims fulfil therefore also the requirements of novelty and inventive step (Articles 33(2) and 33(3) PCT).

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5. The industrial applicability (Article 33(4) PCT) is clearly present for the subject matter of all the claims.

#### **Re Item VI**

##### **Certain documents cited**

According to rule 64.3 (PCT), the attention of the applicant is drawn to document **D3** (WO 00/20929) which has been published (on 13.04.2000) between the priority date (27.09.1999) and the filing date (27.09.2000) of the present application. This document D3 is highly relevant (see Abstract, Fig. 2B, and claim 48) with respect to the subject matter of present apparatus **claims 11-20**.

**Re Item VII**

**Certain defects in the international application**

- 6.1 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
- 6.2 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in document **D1** is not mentioned in the description, nor is this document identified therein.

**Re Item VIII**

**Certain observations on the international application**

The following claims do not meet the requirement of Article 6 PCT in that the subject matter for which protection is sought lacks clarity, conciseness or is not fully supported by the description:-

- 7.1 The expression "holographic image" used in **claim 1** is confusing in that it is not clear whether the holographic image (i.e. the hologram itself) or the reconstructed holographic image is concerned.
- In addition, the description makes it clear that the recording step involves a digital recording. Then, it has been assumed that this term has been introduced into step c (i.e. step c/ : "digitally recording an interference pattern ..") in order to fill the (too large) gap between the steps of "recording an interference pattern" and of "computing a reconstructed holographic image".
- These objections hold also for the subject matter of **claim 11**.
- 7.2 In **claim 2**, the term "microscopic" used in "microscopic image distortion" is vague when related to distortion or lacks an antecedent basis when related to image, therefore, render anyway the subject matter of claim 2 unclear.

- 7.3 **Claims 3 and 12** are superfluous because the added feature is considered to be an essential feature implicitly present in respective independent claim.
- 7.4 In **claim 5**, the term "axial" in "axial scale of the object" lacks an orientational basis. Nevertheless, it has been assumed in this opinion that the axial scale corresponds to the depth of the object (see page 2, lines 1-2).
- 7.5 It appears from page 11, lines 11-12 in the description that the additional step of subtracting should be applied to the interference pattern, not to the computed reconstructed holographic image as stated in **claim 6**. This difference between the claim and the description render the subject matter of claim 6 unclear.
- 7.6 In **claim 7**, the term "image" used is confusing (usually, "recording an image of the object" requires an imaging optic that "images" the object onto the sensor). Instead, it has been assumed that step d/ deals with "digitally recording the optical field reflected by the object" and that step e/ deals with "digitally recording the reference beam only".
- 7.7 Since in **claim 18** the magnifying means cannot be positioned between itself and the recording means, the subject matter of claim 18 is unclear.
- 7.8 In the part "summary of the invention" in the description, it is stated page 11, line 14, that (at the end of the method) the images are "added together for digital interference". In this context, the use of the expression "digital interference" is somehow misleading because confusion can arise with the interferences recorded {cf. step c/, claim 1} and thus implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a).